TELEVISION PROGRAM RECOMMENDER WITH AUTOMATIC IDENTIFICATION OF CHANGING VIEWER PREFERENCES

5 **Field of the Invention**

The present invention relates to television program recommenders, and more particularly, to a method and apparatus for generating television program recommendations.

10 **Background of the Invention**

As the number of channels available to television viewers has increased, along with the diversity of the programming content available on such channels, it has become increasingly challenging for television viewers to identify television programs of interest. Historically, television viewers identified television programs of interest by analyzing printed television program guides. Typically, such printed television program guides contained grids listing the available television programs by time and date, channel and title. As the 20 number of television programs has increased, it has become increasingly difficult to effectively identify desirable television programs using such printed guides.

More recently, television program guides have become available in an electronic format, often referred to as 25 electronic program guides (EPGs). Like printed television program guides, EPGs contain grids listing the available television programs by time and date, channel and title. Some EPGs, however, allow television viewers to sort or search the available television programs in accordance with personalized 30 preferences. In addition, EPGs allow for on-screen presentation of the available television programs.

While EPGs allow viewers to identify desirable programs more efficiently than conventional printed guides, they suffer from a number of limitations, which if overcome, could further 35 enhance the ability of viewers to identify desirable programs.

For example, many viewers have a particular preference towards, or bias against, certain categories of programming, such as action-based programs or sports programming. Thus, the viewer preferences can be applied to the EPG to obtain a set of recommended programs that may be of interest to a particular viewer.

Thus, a number of tools have been proposed or suggested for recommending television programming. The Tivo™ system, for example, commercially available from Tivo, Inc., of Sunnyvale, California, allows viewers to rate shows using a "Thumbs Up and Thumbs Down" feature and thereby indicate programs that the viewer likes and dislikes, respectively. Thereafter, the TiVo receiver matches the recorded viewer preferences with received program data, such as an EPG, to make recommendations tailored to each viewer.

Such tools for generating television program recommendations provide selections of programs that a viewer might like, based on their prior viewing history. While such television program recommenders help a user to identify television programs of interest, they suffer from a number of limitations, which if overcome, could greatly improve the performance in the generated recommendations. For example, with such conventional tools for generating television program recommendations, changes in the television viewing habits of a viewer, often referred to as "non-stationary viewing preferences," are not easily identified. Furthermore, conventional tools for generating television program recommendations consider a person's viewing history as a whole when generating a viewer profile and television program recommendation scores.

In addition, with such conventional tools for generating television program recommendations, it is hard to identify portions of a user's viewing history that can be

deleted. Thus, unnecessary portions of the user's viewing history are often maintained longer than necessary and some desired portions could be prematurely deleted. Generally, if viewing preferences do not change much over time, older viewing histories can be deleted without loss of any performance in the generated recommendations. There is currently no way, however, to determine if the viewer's preferences have changed.

A need therefore exists for methods and apparatus for generating television program recommendations that identify changing viewer preferences. A further need therefore exists for methods and apparatus for generating television program recommendations that adapt television program recommendations to changing viewer preferences.

Summary of the Invention

Generally, a method and apparatus are disclosed for generating television program recommendations based on the prior viewing history of a viewer. According to one aspect of the invention, changes in the viewing preferences are automatically identified. Furthermore, once changing viewing preferences are identified, the disclosed television programming recommender (i) adapts the generated television program recommendations to such changes in viewing preferences, or (ii) more efficiently manages the storage of the viewing history.

For cyclical or periodic changes in viewing preferences, such as repetitive changes corresponding to the time of day or time of year, the television programming recommender generates television program recommendations using a sub-set of the viewing history from a corresponding earlier time period. Likewise, for true or permanent changes in viewing preferences, the television programming recommender optionally generates television program recommendations using the most recent sub-set of the viewing history, which most likely reflects the current

viewing preferences. In another variation, program recommendations can be generated using a combination, such as the union or intersection, of recommendations based on two different periods of time.

5   According to another aspect of the invention, the disclosed television programming recommender identifies portions of a user's viewing history that can be deleted without loss of information. The television programming recommender confirms that viewing preferences have not changed significantly over

10   time, and thereafter deletes older portions of the viewing history without loss of any performance in the generated recommendations.

         Generally, the present invention establishes at least two sub-sets, VH_1 and VH_K, from the available viewing history of

15   a user. The disclosed television programming recommender generates viewer profiles, P_1 and P_K, corresponding to each viewing history sub-set, respectively. Thereafter, the television programming recommender utilizes the viewer profiles, P_1 and P_K, to generate a corresponding set of program

20   recommendation scores for the programs in a given time interval.

         The top-N (where N is a positive integer) recommended television programs, S_1 and S_K, are evaluated. If the two sets of programs, S_1 and S_K, are identical, then the viewer's preferences have not changed significantly. Thus, the oldest

25   portions of the viewing history can be discarded without loss of information. If, however, the two sets of top-N programs, S_1 and S_K, are different, then the television programming recommender has identified a non-stationary viewer preference. In the event that a change in viewing preferences is detected, the television

30   programming recommender can present the user with one or both sets of programs, S_1 and S_K, or a combination of the two sets, such as a union or intersecting set.

A more complete understanding of the present invention, as well as further features and advantages of the present invention, will be obtained by reference to the following detailed description and drawings.

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Brief Description of the Drawings

FIG. 1 illustrates a television programming recommender in accordance with the present invention;

FIG. 2 illustrates the processing of a viewing history in accordance with the present invention;

FIG. 3 is a sample table from the program database of FIG. 1; and

FIG. 4 is a flow chart describing an exemplary viewer preference evaluation process embodying principles of the present invention.

Detailed Description

FIG. 1 illustrates a television programming recommender 100 in accordance with the present invention. As shown in FIG. 1, the television programming recommender 100 evaluates each of the programs in an electronic programming guide (EPG) 110 to identify programs of interest to a particular user. The set of recommended programs can be presented to the user using a set-top terminal/television 150, for example, using well known on-screen presentation techniques. The television programming recommender 100 identifies programs that a viewer might like, based on their prior viewing history 200, discussed further below in conjunction with FIG. 2.

According to one feature of the present invention, discussed further below in conjunction with FIG. 2, the television programming recommender 100 considers sub-sets of the entire viewing history 200 when generating television program recommendations. Thus, the entire viewing history 200 is

analyzed in parts and multiple viewing profiles are generated for a single person. For each sub-set of the viewing history 200, the television programming recommender 100 generates a corresponding user profile that can be utilized to generate television program recommendation scores. In one embodiment, each sub-set of the viewing history 200 is selected by either (i) uniformly randomly sampling sub-sets of television programs from the entire viewing history 200, or (ii) selecting a time span that is less than the entire time period covered by the viewing history 200.

In this manner, the television programming recommender 100 can identify non-stationary viewer preferences. Furthermore, once changing viewing preferences are identified, the television programming recommender 100 can (i) adapt the generated television program recommendations to such changes in viewing preferences, and (ii) more efficiently manage the storage of the viewing history 200. For cyclical or periodic changes in viewing preferences, such as repetitive changes corresponding to the time of day or time of year, the television programming recommender 100 generates television program recommendations using a sub-set of the viewing history 200 from a corresponding earlier time period. Likewise, for true or permanent changes in viewing preferences, the television programming recommender 100 generates television program recommendations using the most recent sub-set of the viewing history 200, which most likely reflects the current viewing preferences.

For example, the viewing habits of many viewers may change temporarily during the fall season with the start of a new television season, or during the playoffs of a given sport. Likewise, the viewing habits of a given viewer may be different in the morning hours as compared to the evening hours. Thus, the performance of the television programming recommender 100 can improve if the portion of the viewing history 200 that is used to

generate the program recommendations more closely resembles the time period of interest. In other words, if a viewer changed his or her viewing preferences, the programs corresponding to the new preferences would appear in the most recent viewing history.

According to another feature of the present invention, the television programming recommender 100 identifies portions of a user's viewing history that can be deleted. The television programming recommender 100 of the present invention can confirm that viewing preferences have not changed significantly over time, and thereby delete older portions of the viewing history without loss of any performance in the generated recommendations.

As shown in FIG. 1, the television programming recommender 100 contains a viewing history 200, discussed further below in conjunction with FIG. 2, a program database 300, discussed further below in conjunction with FIG. 3, and a viewer preference evaluation process 400, discussed further below in conjunction with FIG. 4. Generally, the viewing history 200 contains the set of shows that was watched (and/or not watched) by the viewer over a period of time. The program database 300 records information for each program that is available in a given time interval. The viewer preference evaluation process 400 generates recommendation scores for each program in a particular time interval, taking into account non-stationary viewing preferences in accordance with the present invention, and displays the programs together with an indication of the recommendation score assigned to each program.by the television programming recommender 100.

The television program recommender 100 may be embodied as any computing device, such as a personal computer or workstation. In addition, the television programming recommender 100 may be embodied as any available television program recommender, such as the Tivo™ system, commercially available from Tivo, Inc., of Sunnyvale, California, or the television

program recommenders described in United States Patent Application Serial No. 09/466,406, filed December 17, 1999, entitled "Method and Apparatus for Recommending Television Programming Using Decision Trees," (Attorney Docket No. 700772)

5 and United States Patent Application Serial No. 09/498,271, filed Feb. 4, 2000, entitled "Bayesian TV Show Recommender," (Attorney Docket No. 700690), or any combination thereof, as modified herein to carry out the features and functions of the present invention.

10 FIG. 2 illustrates the processing of the viewing history 200 in accordance with the present invention. As shown in FIG. 2, at least two sub-sets, VH_1 and VH_K, are established from the viewing history 200. The viewing history sub-sets, VH_1 and VH_K, correspond to the sets of shows watched by the viewer

15 during time spans T_1 and T_2, respectively. In the example shown in FIG. 2, time spans T_1 and T_2 are non-overlapping. The time spans T_1 and T_2 could easily be overlapping, however, as would be apparent to a person of ordinary skill in the art. Furthermore, one or both time spans T_1 and T_2 can be discontinuous, and need

20 not be of equal duration. The illustrative viewing history sub-sets, VH_1 and VH_K, correspond to time spans that are less than the entire time period covered by the viewing history 200. If a viewer changed his or her viewing preferences from time span T_1 to time span T_2, the programs corresponding to the new

25 preferences would appear in time span T_2.

As shown in FIG. 2, and discussed further below in conjunction with FIG. 4, the television programming recommender 100 in accordance with the present invention generates a viewer profile, P_1 and P_K, corresponding to each time span,

30 respectively. Thereafter, the television programming recommender 100 utilizes the viewer profiles, P_1 and P_K, to generate a corresponding set of program recommendation scores for the programs in a given time interval.

The television programming recommender 100 then processes the corresponding top-N (where N is a positive integer) sets of recommended programs, S_1 and S_K. If the two sets of programs, S_1 and S_K, are identical, then the viewer's preferences have not changed, or at least have not changed enough so that the television programming recommender 100 can perceive the difference. Thus, the oldest portions of the viewing history 200 (VH_1 in the present example) can be discarded.

If, however, the two sets of programs, S_1 and S_K, are different, with some number of programs in common, then the television programming recommender 100 has identified the common thread. Finally, if the two sets of programs, S_1 and S_K, are different, with no programs in common, then the viewer's preferences have changed completely between the two selected time periods. In the event that a change in viewing preferences is detected, the television programming recommender 100 can present one or both sets of programs, S_1 and S_K, or a combination of the two sets, such as a union or intersecting set.

FIG. 3 is a sample table from the program database 300 of FIG. 1 that records information for each program that is available in a given time interval. As shown in FIG. 3, the program database 300 contains a plurality of records, such as records 305 through 320, each associated with a given program. For each program, the program database 300 indicates the date/time and channel associated with the program in fields 340 and 345, respectively. In addition, the title and genre for each program are identified in fields 350 and 355. Additional well-known attributes (not shown), such as actors, duration, and description of the program, can also be included in the program database 300.

In accordance with one feature of the present invention, the program database 300 also records an indication of the recommendation score assigned to each program by the

television programming recommender 100 in field 370. In this manner, the numerical scores can be displayed to the user in the electronic program guide with each program directly or mapped onto a color spectrum or another visual cue that permits the user to quickly locate programs of interest.

FIG. 4 is a flow chart describing an exemplary viewer preference evaluation process 400 embodying principles of the present invention. As shown in FIG. 4, the viewer preference evaluation process 400 initially obtains the electronic program guide (EPG) 110 during step 410 for the time period of interest. Thereafter, the viewer preference evaluation process 400 obtains at least two sub-sets, VH_1 and VH_K, from the viewing history 200 during step 420 and generates a viewer profile, P_1 and P_K, corresponding to each sub-set, VH_1 and VH_K during step 430.

The viewer profiles, P_1 and P_K, are utilized during step 440 to generate a corresponding set of program recommendation scores, S_1 and S_K, for the programs identified in the EPG 110 for a given time interval. A test is performed during step 450 to determine if the top-N shows from S_1 and S_K are the same. If it is determined during step 450 that the top-N shows from S_1 and S_K are the same, then the viewing preferences have not changed significantly over time, and a portion of the viewing history 200 can be deleted during step 460 without loss of information.

If, however, it is determined during step 450 that the top-N shows from S_1 and S_K are not the same, then the viewing preferences have changed significantly over time, and the recommendations should be presented to user during step 470 based, for example, on used-defined preferences. For example, the user can specify that detected changes in viewing preferences are likely permanent and that the most recent sub-set, VH_K, of the viewing history 200 should always be used to generate recommendations. Alternatively, the user can specify that

detected changes in viewing preferences are likely temporary and that some combination of the two sub-sets, VH_1 and VH_K, of the viewing history 200, such as a union or intersection of the two sub-sets, should be used to generate recommendations. In addition, the user can specify that detected changes in viewing preferences are likely cyclical in nature and that a sub-set, VH_K, from a corresponding (similar) earlier time period should be used to generate recommendations.

It is to be understood that the embodiments and variations shown and described herein are merely illustrative of the principles of this invention and that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention.